MYCOTAXON
ISSN (print) 0093-4666 (online) 2154-8889 Mycotaxon, Ltd. ©2019

April–June 2019—Volume 134, pp. 353–357
https://doi.org/10.5248/134.353

Two *Heterostelium* species newly recorded from China

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Abstract—Two species of dictyostelid cellular slime molds new to China (*Heterostelium anisocaule* and *H. arachnoideum*) were isolated from samples of soil/humus collected in East China. Descriptions and illustrations based on these isolates are provided.

Key words—*Amoebozoa,* taxonomy, forest soils

Introduction

Dictyostelid cellular slime molds (dictyostelids) are key components of the soil microbiota and play a role in maintaining the balance that exists between bacteria and other organisms (Raper 1984). Dictyostelids have been reported from several localities in China (He & Li 2010; Liu & Li 2012a,b, 2014, 2017; Liu & al. 2019), but there are relatively few reports of this group from East China (Yeh & Chien 1983, Hagiwara & al. 1985, Zhao & al. 2017). East China includes Shandong Province, Jiangsu Province, Anhui Province, Zhejiang Province, Jiangxi Province, Fujian Province, Shanghai, and Taiwan. Two species of dictyostelids, reported originally from the Southern Hemisphere, were isolated from samples of soil/humus collected from this region. Descriptions and illustrations based on these isolates are provided herein.

Materials & methods

Samples were collected during 2012 from Jiangsu Province, Fujian Province, and Taiwan. Each sample consisted of 30–50 g of soil/humus and was placed in a sterile whirl-pack plastic bag. Each sample bag was numbered and the sample itself preserved at 4 °C in the herbarium of the Mycological Institute of Jilin Agricultural University, Changchun, China (HMJAU). Isolation methods followed Cavender & Raper (1965), with some minor modifications outlined by Liu & al. (2019). Isolates were identified with reference to Raper (1984) and following the new classification system of Sheikh & al. (2018). The characteristic stages in the life cycle, including cell aggregation and the formation of pseudoplasmodia and sorocarps, were observed under a Zeiss Axio Zoom V16 dissecting microscope with a 1.5× objective and 10× ocular. Slides with sorocarps were prepared with water as the mounting medium. Features of spores, sorophores, and sorocarps were observed and measured using a Zeiss Axio Imager A2 light microscope with 10× ocular and 10, 40, and 100× (oil) objectives. Photographs were taken with Zeiss Axiocam 506 color microscope camera. Spores from these plates were frozen in HL 5 media (Cocucci and Sussman 1970) and stored at – 80 °C in HMJAU.

Taxonomy

Heterostelium anisocaule (Cavender & al.) S. Baldauf, S. Sheikh & Thulin, Protist 169: 14. 2018. PLATE 1a–e

When cultured at 23 °C on non-nutrient agar with *Escherichia coli*, sorocarps white, erect to prone, solitary to clustered, prostrate, phototropic, normally 3–9 mm. Sorophores asymmetrical, sinuous, with 1–7 whorls, each whorl comprising 1–4 branches. Sorophore tips and the upper portion of the sorophore consist of one tier of cells, bases round. Terminal sori white, globose, commonly 60–160 µm in diam. Lateral sori white, globose, 15–85 µm in diam. Spores elliptical 5–9.5×3–5.5 µm, with unconsolidated granules. Aggregations of the "violaceum" type.

SPECIMEN EXAMINED– **CHINA, JIANGSU PROVINCE, Jintan**, Mao Mountains, soil (S2593) collected in broadleaf forest, 19 Aug. 2012, Liu & al.; isolated in 2014 (HMJAU MR174).

COMMENTS—*Heterostelium anisocaule* was first isolated from a sample collected in a podocarp/broadleaf forest in Northland, New Zealand. This species has a wide range of temperature adaptation (18–30 °C). Variations in temperature and light exposure result in a considerable variation in sorocarp size. The optimum temperature is 22–23 °C (Cavender & al. 2002).

Heterostelium arachnoideum (Vadell & Cavender) S. Baldauf, S. Sheikh & Thulin, Protist 169: 14. 2018. PLATE 1f–n

When cultured at 23 °C on non-nutrient agar with *E. coli*, sorocarps white, erect to prone, sometimes prostrate, solitary to clustered, with slightly phototropic growth, 5–14 mm or more. Sorophores asymmetrical, with 3–20 whorls, each whorl with 2–5 uneven branches. The lower portion of the

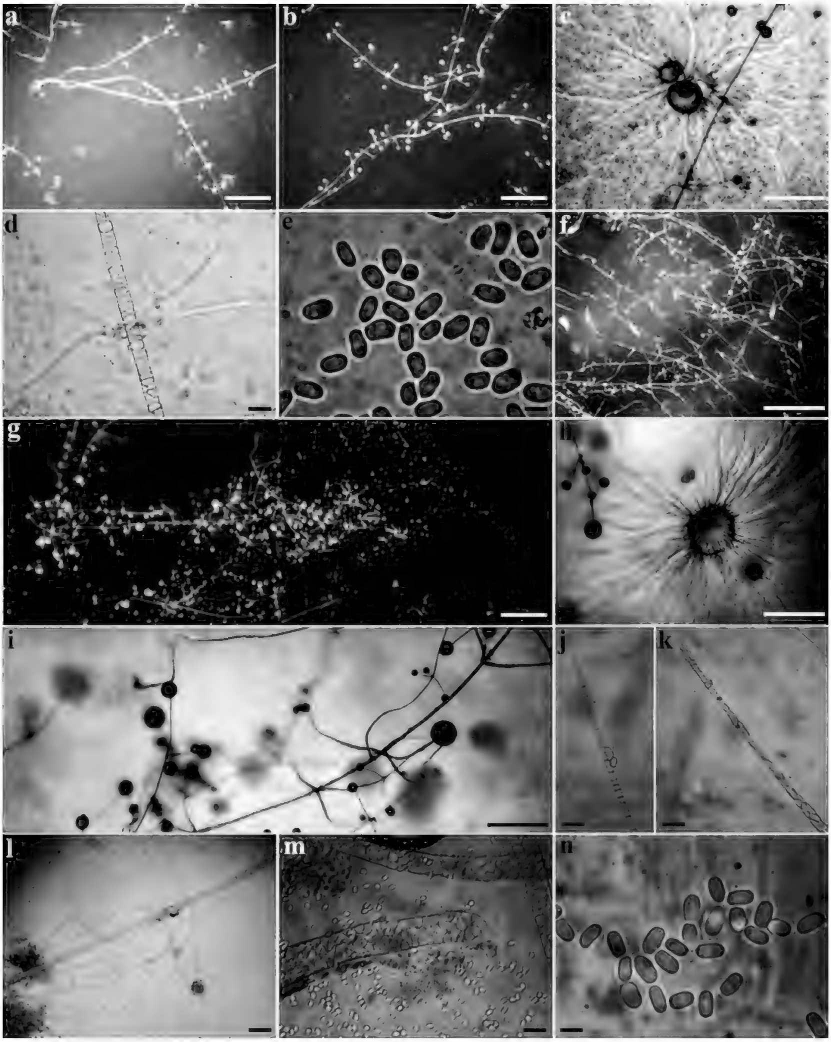

Plate 1. ***Heterostelium anisocaule***: a, b. Sorocarps; c. Aggregation; d. Sorophores and branches; e. Spores. ***Heterostelium arachnoideum***: f, g, i. Sorocarps; h. Aggregation; j, k. Sorophore tip; l. Sorophores and branches; m. Sorophore base; n. Spores. Scale bars: a, b, f, g = 1 mm; c,h = 100 µm; d, j, k = 20 µm; e, n = 5 µm; i = 0.5 mm; l = 50 µm; m = 30 µm.

sorophore sometimes with secondary whorls. Sorophore tips consist of one tier of cells, sinuous, becoming tangled together to form a delicate spider-web-like structure, especially sometimes without sori present. Bases clavate, irregular. Terminal sori white, globose, commonly 30–135 µm in diam. Lateral sori white, globose, commonly 20–50 µm in diam. Spores elliptical or oblong, mostly 5.5–8×3–4.5, with unconsolidated polar granules. Aggregations of the "violaceum" type. Late sorogens sometimes curved.

Specimen examined– Specimen examined: **CHINA, Jiangsu Province, Yixing**, soil (S2570) collected in broadleaf forest, 22 Aug. 2012, Liu & al.; isolated in 2014 (HMJAU MR175). **Fujian Province, Fuzhou**, Gu Mountain, soil (S2031) collected in mixed forest, 11 Mar. 2012, Liu & al.; isolated in 2014 (HMJAU MR209). **Taiwan, Yilan**, Lotung Sports Park, soil (S2936) collected in humus, 11 Sep. 2012, Liu & al.; isolated in 2014 (HMJAU MR210).

Comments—*Heterostelium arachnoideum* was originally isolated from soil litter collected from three sites within Iguazú National Park, Misiones, Argentina. This species is characterized by its spider web-like terminal sorophores (Vadell & Cavender 2007).

Acknowledgments

We wish to express our appreciations to two peer reviewers Prof. Steven L. Stephenson (University of Arkansas, USA) and Prof. John C. Landolt (Shepherd University, WV USA) for their valuable comments relating to this manuscript. This study was supported by the National Natural Science Foundation of China (No. 31870015, 31300016), Science and Technology Development Program of Jilin Province (No. 20180101273JC), 111 Project (No. D17014), and the Science and Technology Research Programs of the Education Department of Jilin Province in the Thirteenth Five–Year Plan (No. JJKH20180671KJ).

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